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## PROBLEMS FOR SOLUTION.

SEND ALL COMMUNICATIONS ABOUT PROBLEMS TO B. F. FINKEL, Springfield, Mo.

## ALGEBRA.

**479. Proposed by S. A. COREY, Albia, Iowa.**

Prove or disprove

$$\left\{ \begin{vmatrix} x & -v & -z \\ -y & -z & v \\ -z & y & -x \end{vmatrix}^2 + \begin{vmatrix} y & -v & -z \\ x & -z & v \\ v & y & -x \end{vmatrix}^2 + \begin{vmatrix} x & y & -z \\ -y & x & v \\ -z & v & -x \end{vmatrix}^2 + \begin{vmatrix} x & -v & y \\ -y & -z & x \\ -z & y & v \end{vmatrix}^2 \right\} \div \begin{vmatrix} x & -y & -z & v \\ y & x & -v & -z \\ z & v & x & y \\ v & -z & y & -x \end{vmatrix}^2 = (x^2 + y^2 + z^2 + v^2)^{-1}.$$

**480. Proposed by FRANK IRWIN, University of California.**

Solve the equation

$$(x-1) - 2\left(1 - \frac{1}{x}\right) - 3\left(1 - \frac{1}{x}\right)\left(1 - \frac{2}{x}\right) - 4\left(1 - \frac{1}{x}\right)\left(1 - \frac{2}{x}\right)\left(1 - \frac{3}{x}\right) - \dots \\ - n\left(1 - \frac{1}{x}\right)\left(1 - \frac{2}{x}\right) \dots \left(1 - \frac{n-1}{x}\right) = 0.$$

Also the equation

$$(x-a_1) - a_2\left(1 - \frac{a_1}{x}\right) - a_3\left(1 - \frac{a_1}{x}\right)\left(1 - \frac{a_2}{x}\right) - \dots \\ - a_n\left(1 - \frac{a_1}{x}\right)\left(1 - \frac{a_2}{x}\right) \dots \left(1 - \frac{a_{n-1}}{x}\right) = 0.$$

[Adapted from a formula of Tait's.]

## GEOMETRY.

**512. Proposed by J. L. RILEY, Northeastern State Normal School, Tahlequah, Okla.**

Determine, geometrically, where the circle of curvature at any point of an ellipse again meets the ellipse.

**513. Proposed by ALBERT A. BENNETT, University of Texas.**

The following construction for angle-trisection was given some years ago in a non-mathematical journal. Let  $ABC$  be a right triangle with  $AB$  as hypotenuse. Let  $BD$  be a ray drawn parallel to  $AC$  and extending in the same direction. Let  $AEEF$  be a variable ray meeting the segment  $BC$  in  $E$ , and the ray  $BD$  in  $F$ . Show, by elementary methods, that when the variable ray is so adjusted that  $EF = 2AD$ , then  $\angle EAC = \frac{1}{3} \angle BAC$ .

## CALCULUS.

**427. Proposed by ROGER S. JOHNSON, Adelbert College, Cleveland, Ohio.**

Of all ellipses circumscribed about a given parallelogram, the maximum, with regard to area, has as conjugate diameters the diagonals of the parallelogram.

**428. Proposed by J. L. RILEY, Northeastern State Normal School, Tahlequah, Okla.**

A loop of a lemniscate rolls in contact with the axis of  $x$ . Prove that the locus of the node is given by the equation

$$1 + \frac{dy}{dx} = \left(\frac{a}{y}\right)^{\frac{4}{3}}$$

and that  $2\rho\rho' = a^2$ , if  $\rho, \rho'$  be corresponding radii of curvature of this locus and the lemniscate.